

Community Research in Tuberculosis Muscogee County, Georgia

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EIGHTEEN YEARS ago, in 1946, the Public Health Service, in cooperation with the Muscogee County Health Department and assisted by the Georgia Department of Public Health, undertook to establish in a community of about 100,000 people a cooperative facility with the principal purpose of combining effective tuberculosis control and a broad basic epidemiologic study of tuberculosis (bibliog. 1). This cooperative facility was the Muscogee County Tuberculosis Study, one of a series of communitywide studies conducted by tuberculosis investigators, who for a long time had a virtual monopoly on this type of population-based research.

Probably the first community study in this country was the Health Demonstration Program, conducted in Framingham, Mass., from 1917 to 1923. Despite its limited sample size and its use of diagnostic methods which would now be considered inadequate, its conclusion that there were nine active cases in the community for every annual tuberculosis death provided a major basis for program planning for many years.

During the 1930's, a considerable number of countywide tuberculosis studies were initiated,

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including those in Cattaraugus County, N.Y.; St. Louis County, Minn.; Lee and Coffee Counties, Ala.; and Giles and Williamson Counties, Tenn. Although the contributions of these studies to our knowledge are not reviewed here, students of tuberculosis will recognize that the Muscogee County Tuberculosis Study was built to a considerable extent upon foundations suggested by its predecessors.

The Muscogee County study had three principal architects. The fundamental pattern was laid down by Dr. Jacob Yerushalmy before he left the Public Health Service for his present position as professor of biostatistics at the University of California. Arranging a suitable setting for a program of community research was the responsibility of a remarkably astute practitioner of public health, Dr. James A. Thrash, who was health officer of Muscogee County from 1940 until his death in 1962. But the principal architect of the study was Dr. Carroll E. Palmer, whose insistence upon broad coverage, standardized test procedures, and quantitative, independent measurements made it possible to achieve results which could not only stand by themselves but would also allow reasonable comparisons with results obtained elsewhere by the Public Health Service and the World Health Organization.

It is hardly surprising that the interests of these three men are reflected in the major features of the study. First, it was to be based on the entire population of the county. To achieve this end, a complete census and housing survey was conducted in 1946. A broad foundation for subsequent investigations was then provided by matching the results of two

communitywide X-ray surveys and two tuberculin surveys to the 1946 census population.

A second major feature of the study was the integration of service and research. Tuberculosis control activities ordinarily provide considerable information about the pattern of disease in the community. To make this information as complete as possible, the services of the Muscogee County Health Department were strengthened to provide unusual competence in all areas of tuberculosis control. Many tuberculosis cases, contacts, and suspects were cared for directly by the health department, including almost all of those known to public agencies. In addition, some consultative or diagnostic services were provided to nearly all tuberculosis patients of private physicians. Although official reporting of tuberculosis was probably no better than elsewhere, the unofficial reporting achieved by such services appears to have been virtually complete.

Finally, standardized diagnostic procedures were applied as uniformly as possible, with independent interpretations of the results whenever possible. To minimize observer differences between projects sponsored by the Public Health Service, personnel from other studies were often assigned temporarily to Muscogee County. But, over and above these procedural matters was long-range planning for one study to complement and reinforce the findings from another.

In the 18 years since the study was started, its findings have contributed to 31 papers listed in chronological order of publication in the bibliography. Selections from these papers illustrate the scope of the study and some of the changes that have occurred in the past two decades, both in tuberculosis and in our concepts about the disease.

To set the stage, it is helpful to review some opinions widely held in 1946. It was then generally believed that any reaction to tuberculin resulted from infection with the tubercle bacillus. The close temporal relationship of disease and exposure to tuberculosis was stressed, and a person with a positive tuberculin reaction of several years standing was considered to have little chance of developing tuberculosis unless he was repeatedly exposed to an infectious case. In the jargon of tuberculosis workers, exogenous reinfection was highly favored over endogenous

reinfection as the pathogenesis of most tuberculous disease. And even though a number of analyses showed that the burden of tuberculosis mortality was shifting to the older ages, especially among males, there was a strong tendency to think of tuberculosis as a disease of adolescence and early adult life.

These views of tuberculosis naturally influenced the measures suggested for its control. Concern for the high risk of disease believed to follow tuberculous infection led to mass campaigns of BCG vaccination of children as the principal means of tuberculosis control in much of the postwar world. Even in this country, favorable reports on its use prompted the initiation of large-scale controlled trials of BCG vaccination by the Public Health Service. But a far more popular procedure here was the mass chest X-ray survey. Again, its usefulness was thought to be related to the risks of disease among those who had recently been infected or reinfected. There was considerable hope that complete detection, isolation, and treatment of infectious cases would be quickly followed by a dramatic drop in the incidence of new cases of tuberculosis.

The 1946 Survey and Followup

The evaluation of both these procedures—mass X-ray surveys and BCG vaccination—was a major function of the Muscogee County Tuberculosis Study. In 1946, Muscogee County was the site of the second communitywide venereal disease-tuberculosis survey sponsored by the Public Health Service. This project was followed by a complete census of the county. After survey and census records had been matched, it was possible to identify two groups—those residents who had been examined in the survey and those who had not—and in this way to evaluate the coverage of a mass survey (bibliog. 2). Participation was much better among Negroes than among whites. Children under 12 years of age were not eligible for this survey, but coverage among older children of school age was very good. Middle-aged adults also participated well, but only 30 percent of the population over 65 years of age was examined.

In addition to the difficulties in achieving complete coverage of the population, mass sur-

Table 1. Average tuberculosis death rates in 7 years after survey among 1946 census population, by 1946 survey status

1946 survey status	1946 population	Observed deaths	Adjusted death rates
X-rayed.....	38, 190	82	24. 4
Not X-rayed.....	57, 176	52	22. 3

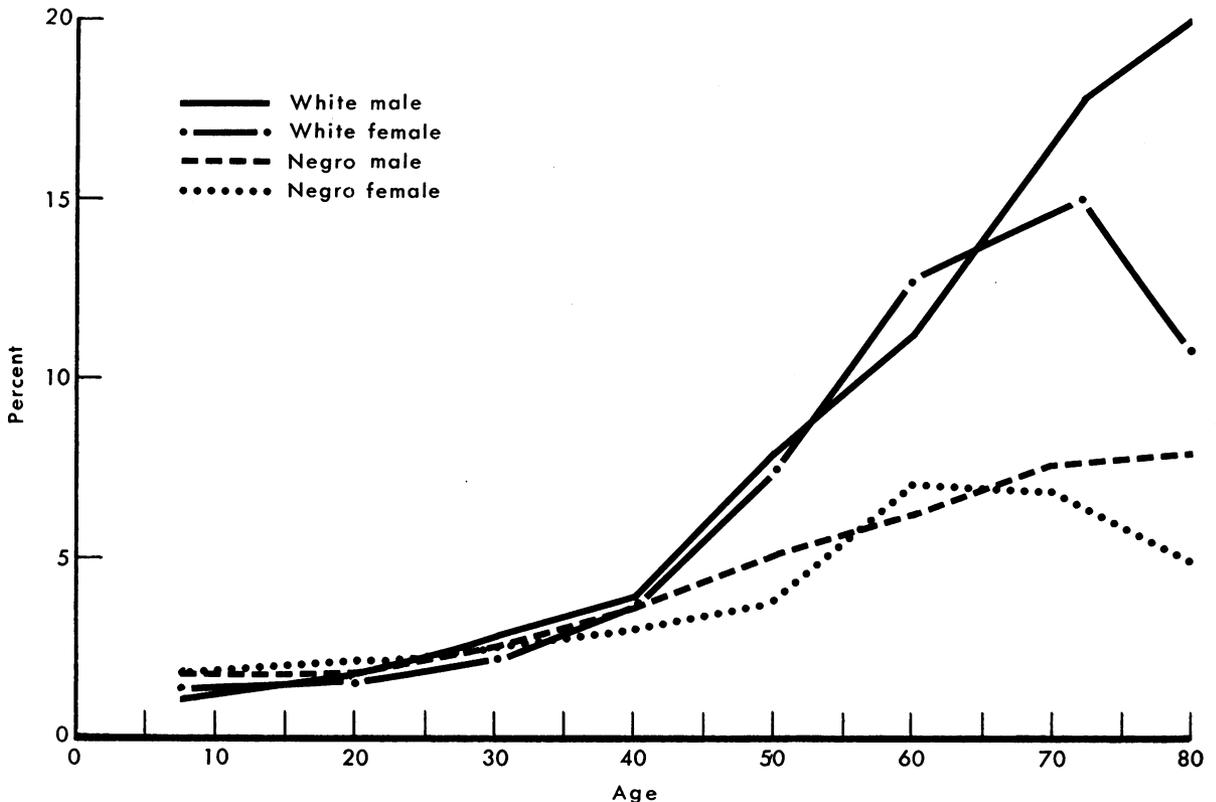
veys were frequently criticized on the grounds that tuberculosis was likely to be more prevalent among persons who did not participate in them. This charge does not seem valid for the survey in Muscogee County. Table 1 shows the numbers of persons X-rayed and not X-rayed in the 1946 survey (bibliog. 13). A large proportion of those not X-rayed is composed of persons at the extremes of life, young children who were not eligible for the survey and old people who chose not to participate. In the subsequent 7 years, 82 tuberculosis deaths occurred among the survey participants and only

52 among the nonparticipants. When the mortality rates are adjusted for race, sex, and age differences in the two populations, there is no indication that tuberculosis was concentrated in either group, the two rates being nearly identical. The conclusion that persons with tuberculosis did not attempt to evade the survey is strengthened by a similar but unpublished study of tuberculosis morbidity.

Among those who did participate, the prevalence of findings suggestive of tuberculosis is shown in figure 1 (bibliog. 2). For each of the four race-sex groups, prevalence increased with age. Among the youngest age groups, the prevalence among Negroes was slightly higher than among whites, but after the age of 40, whites had a much higher proportion of persons with X-ray shadows suggestive of tuberculosis. In fact, one of every six whites over the age of 65 was classified as a tuberculosis case or suspect.

Although only a small proportion of the abnormalities detected in the survey was initially

Figure 1. Percent recalled as "tuberculosis" or "suspect," Muscogee County Survey, 1946



classified as active tuberculosis, long-term followup of the entire survey positive group has shown that reactivation of disease over a 5-year period ranged from 2 percent among older whites with minimal disease to as high as 30 percent of younger Negroes with advanced disease. In other words, the risk of reactivation was greater for extensive than for slight lesions, greater for Negroes than for whites, and greater for young adults than for older persons. Looking back on the survey, although a number of infectious cases were detected and isolated at the initial followup examination, the greatest benefits probably accrued from the detection of active disease in the course of long-term surveillance of persons originally thought to have only suspected or inactive tuberculosis.

The 1946 survey also identified a large number of persons with negative chest X-rays. And because the films had been independently interpreted by two readers, it is fairly certain that they were truly negative. As new cases of tuberculosis were detected by continued and extensive

X-ray screening of the community, matching of case reports with the survey-census file allowed an estimate of incidence to be made. The rates by race, sex, and broad age groups are shown in figure 2 (bibliog. 12).

The first pair of bars represents white males, followed in order by white females, Negro males, and Negro females. In each pair, the left-hand bar represents rates among persons under 45 years of age, and the right-hand bar, rates among older persons. The different shadings within each bar signify the classification of disease by an independent reviewer. Class 1 signifies pulmonary cases with positive bacteriological findings; class 2, probable tuberculosis, but without positive bacteriological findings; and class 3, the suspects.

Incidence rates among whites were appreciably lower than among Negroes, and for each race, slightly lower among females than among males. Among whites, older persons tended to have higher rates than young adults. For Negroes, the reverse age trend was noted, with

Figure 2. New cases per 1,000 survey negatives in 5 years

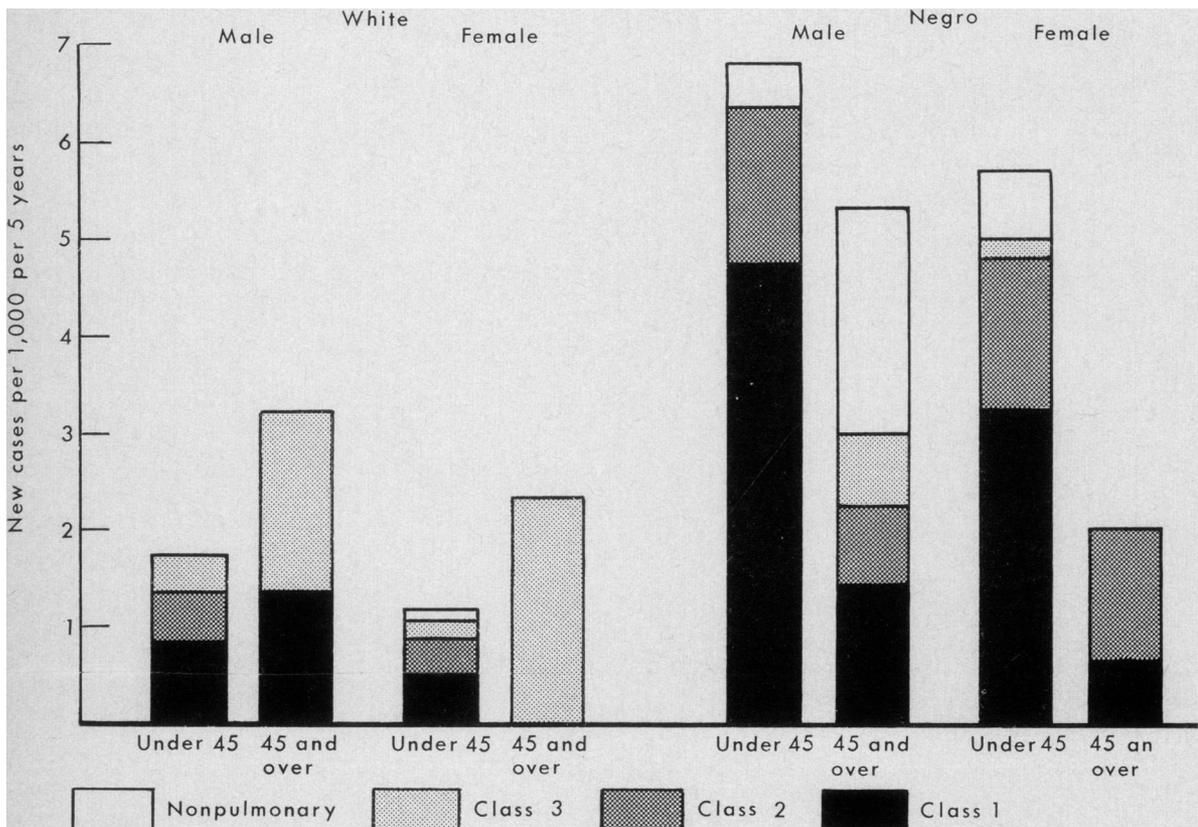


Table 2. Cases of definite tuberculosis among study participants and average annual rates per 100,000 population, by tuberculin and vaccination status, Muscogee County, Ga.

Item	Total	Reactors to 5 TU	Nonreactors to 5 TU			
			Not tested with 100 TU	Reactors to 100 TU	Nonreactors to 100 TU	
					Controls	Vaccinees
Participants.....	11, 262	1, 492	741	3, 768	2, 341	2, 498
Definite cases.....	35	24	2	5	2	2
Average annual rates per 100,000.....	25. 9	134. 0	22. 5	11. 1	7. 1	6. 7

NOTE: 422 nonreactors to 100 TU classified as "irregulars" had no cases of tuberculosis and, although included in the total, are not shown separately in the table.

higher rates among young adults. The differences in incidence between the races and between the sexes are consistent with the proportion of positive tuberculin reactors in each group, and it seems reasonable that development of disease might follow the pattern of tuberculous infection. However, this simple explanation does not account for the differing age patterns of incidence between whites and Negroes, and we must admit that we still do not know why tuberculosis flourishes in some persons and not in others.

Evaluating BCG Vaccination

Another major function of the Muscogee County Tuberculosis Study was to contribute to the evaluation of BCG vaccination as a public health measure. To this end, two controlled trials of BCG vaccination were undertaken. The first, in 1947, included more than 11,000 school children; and the second, in 1950, about 64,000 persons between 5 and 85 years of age.

The school trial was done at a time when it was still considered necessary to test with a strong dose of tuberculin before vaccination with BCG in order to exclude persons who had already been infected with tubercle bacilli. Consequently, all participants were tested first with 5 units of PPD, and nonreactors to that dose were tested again with 100 units of PPD. Those who did not react to the larger dose were then divided into two groups, one of which was to be vaccinated and the other left unvaccinated as a control.

After 12 years of followup, it was apparent

that BCG vaccination of school children was not likely to be a useful procedure in most areas of the United States. The basis for this conclusion is summarized in table 2 (bibliog. 23). The study population of 11,000 children was divided into 5 groups. The first comprised less than 1,500 children who reacted to the 5 TU dose of PPD. A smaller group did not react to this intermediate dose, but failed to complete the second test with 100 TU. About 3,800 children reacted to a second dose, and they were also ineligible for vaccination. The remainder were divided into two groups, controls and vaccinees. During the next 12 years, 35 cases of definite tuberculosis were detected in the study population. Twenty-four cases, or 70 percent of the total, developed among the small group of reactors to the 5 TU test. The numbers of cases in the other groups are too small for any valid conclusions except that the tuberculosis risk was largely limited to reactors to the intermediate dose of tuberculin, a group for which BCG offers no known benefits.

By 1950, it was already obvious that the school study population would not yield enough cases of tuberculosis to answer many of the questions about BCG. Consequently, two large controlled trials of BCG vaccination were initiated. One including nearly 200,000 children was conducted in Puerto Rico, and a companion study of 64,000 persons was done in Muscogee County and its neighbor, Russell County, Ala. By this time, the second dose of PPD was no longer used to determine eligibility for vaccination and the study population was therefore composed of only three groups—reactors to the

intermediate dose and two groups of non-reactors, randomly divided into controls and vaccinees.

A summary of the findings of these two larger trials is given in table 3 (bibliog. 17). A in table 3 shows the observed numbers of cases divided according to their initial tuberculin status. For the trial in Muscogee and Russell Counties, the period of observation is 7 years; for Puerto Rico the findings have been extended to 9 years, 2 years longer than in the initial report. The Puerto Rican cases now total 1,352 (1,041 among persons classified as initial reactors, 103 among nonreactors refusing vaccination, 86 among controls, and 122 among vaccinees). In order to assess the benefits of BCG vaccination as a public health procedure, it is first necessary to determine the number of cases that would have developed without any vaccination. This is shown in B. The numbers of cases among reactors do not change, of course, since in any case they are not vaccinated. The potential problem among nonreactors is obtained by applying the observed tuberculosis case rates among controls to the vaccinated population, and adding to these estimated numbers the cases observed among controls and nonreactors who refused vaccination, yielding the figures shown in B.

Next, it is necessary to determine the numbers of cases which would have developed if all nonreactors had been offered vaccination. This is shown in C. Once again, the numbers of cases among reactors are unchanged. The nonreactor cases are obtained in this instance by applying the case rates among vaccinees to the controls, and adding these cases to those observed among vaccinees and refusals with the results as given in C. Finally, the estimated reduction in cases by offering BCG to all non-reactors is shown in D. These estimates are obtained by simple subtraction of the total cases in C from the totals in B. The potential tuberculosis problem during a 7- to 9-year period was reduced by 101 cases (81 plus 20) as a result of a vaccination program involving a quarter of a million persons. It seems more than possible that a similar investment of resources in other methods of tuberculosis control would have been more rewarding. In addition, the usefulness of the tuberculin test for diag-

nostic and epidemiologic purposes has been reduced by the vaccination programs in both Georgia and Puerto Rico.

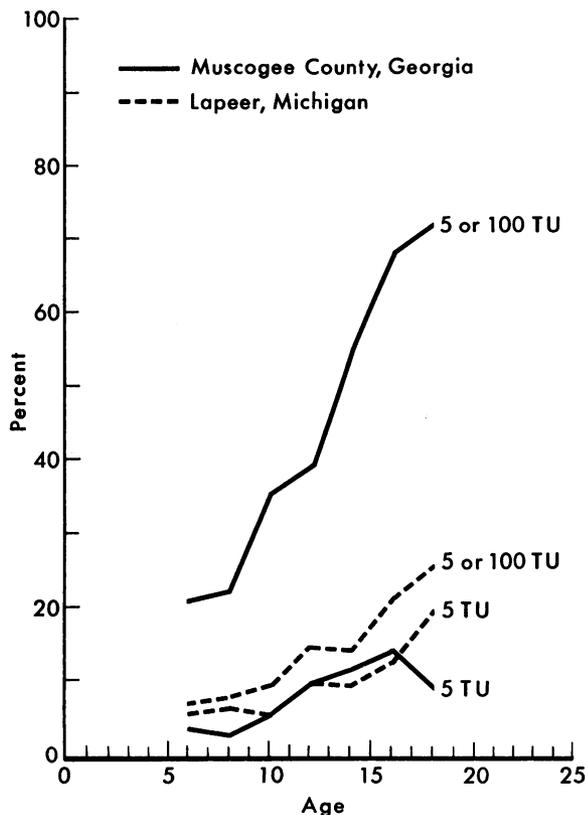
Furthermore, the apparent benefits from BCG vaccination have diminished since the previous report (bibliog. 17), largely because the case rate among controls declined more rapidly than that among vaccinees during the last few years of observation. This finding raises the question of how many cases of tuberculosis were prevented by BCG and how many merely had a delayed onset. Only continued observation can provide an answer.

The disappointing results from BCG vaccination, plus the fact that the tuberculosis problem in this country was concentrated among persons who had been infected some time in the past, obviously called for another approach. This need led the Public Health Service to embark upon its series of large-scale trials of isoniazid prophylaxis, in an eventually successful effort to find a means of preventing active tuberculosis among those whose risk had

Table 3. Recapitulation of the potential usefulness of BCG

Item	Puerto Rican trial	Muscogee-Russell trial
A. Observed cases:		
Total.....	1,352	206
Reactors.....	1,041	161
Nonreactors.....	311	45
B. Estimated cases if no non-reactors had been vaccinated (tuberculosis problem):		
Total.....	1,389	216
Reactors.....	1,041	161
Nonreactors.....	348	55
C. Estimated cases if all non-reactors had been offered vaccination:		
Total.....	1,308	196
Reactors.....	1,041	161
Nonreactors.....	267	35
D. Estimated reduction if all non-reactors had been offered vaccination:		
Number.....	81	20
Percent of tuberculosis problem.....	5.8	9.3

Figure 3. Percent reacting to 5 TU compared with percent reacting to either 5 or 100 TU



been shown to be greatest—the positive reactors and those with inactive tuberculosis (bibliog. 27, 28).

Geographic Comparisons

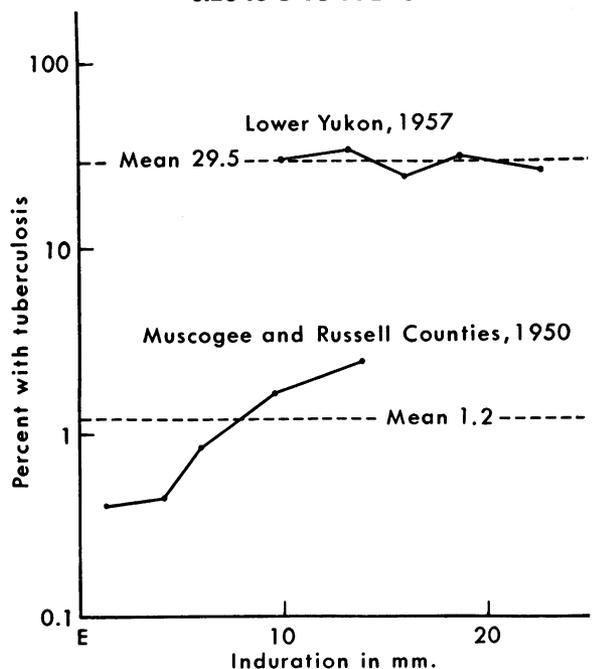
The BCG trials also led to other important findings. One of the earliest contributed to the recognition that sensitivity to a strong dose of tuberculin showed marked geographic differences which did not correlate with the usual indices of tuberculosis. The results of testing two school-age populations with 5 TU and 100 TU doses of PPD are shown in figure 3 (bibliog. 6). The solid lines represent the prevalence of reactors by age in Muscogee County, while the broken lines indicate the prevalence in Lapeer, Mich. In each instance, the lower lines show the prevalence of reactors to the 5 TU dose, which was essentially the same for both areas. But, whereas a second test using 100 TU added only a few more reactors in Michigan, the second dose added tre-

mendous numbers in Georgia. And yet, as far as could be determined, the tuberculosis problem was similar in the two areas. Findings such as these soon made it clear that second dose reactions were almost certainly caused by something other than tuberculosis and that the prevalence of sensitivity to this other agent or agents varied tremendously from one part of the country to another.

Other geographic comparisons have shed light on the relationship of the size of the tuberculin reaction to the likelihood of having tuberculous disease. A prerequisite for such a study, of course, is that the index of tuberculin sensitivity be measured independently from the index of tuberculous disease. This condition was met both in the 1950 BCG program in Muscogee County and in a 1957 survey along the lower Yukon River in Alaska. Figure 4 shows the prevalence of tuberculous disease by size of induration to 5 TU of PPD in the two areas (bibliog. 19).

The lower curve represents the situation in Muscogee County in 1950, which led to one of the earliest reports that the likelihood of having tuberculous disease increased directly with the size of reaction to tuberculin. This relationship

Figure 4. Prevalence of tuberculosis by reaction size to 5 TU PPD-S



was confirmed in other studies (bibliog. 23), but it still remained difficult to tell which of two hypotheses provided the most reasonable explanation for this association. One hypothesis was that there was something intrinsically harmful about allergy to tuberculin, so that persons with high degrees of allergy were more likely to have infections which resulted in demonstrable disease. The second hypothesis was that the likelihood of disease was basically related to the likelihood of having been infected by tubercle bacilli, and that persons with large reactions were more likely to have tuberculous disease because they were more likely to be truly infected than persons with small reactions.

Although the findings in Muscogee County fit either of the two hypotheses, those in Alaska strongly favor the second. As can be seen from the upper part of figure 4, the likelihood of having tuberculosis is essentially the same in the Alaska population regardless of the size of the tuberculin reaction. This indicates that strong allergy is not necessarily more harmful than lesser degrees of sensitivity.

Other evidence has shown that the only demonstrable source of tuberculin sensitivity in native Alaskans is the tubercle bacillus. In Muscogee County, on the other hand, most of the tuberculin reactions, and particularly the smaller ones, now appear to result from infections with unclassified mycobacteria.

Exploring Other Subjects

Many other subjects have been explored in Muscogee County through the resources of this cooperative facility. Studies of mycobacterial cervical adenitis among children have indicated that this disease is often caused by members of the group of unclassified mycobacteria (bibliog. 25). Observations of solitary pulmonary nodules detected in routine X-ray screening examinations have shown only a relatively small proportion to be malignant, as contrasted with the high proportion of malignancies found after the selective processes of physician and patient judgment have winnowed them down to the group finally submitted to surgery (bibliog. 14).

The cardiovascular field has also been investigated. A random sample of the 1946 census population has had blood pressure carefully

measured on two occasions, 7 years apart (bibliog. 15). And another followup study of the 1946 survey showed that one-fourth of the cardiovascular deaths over a 3-year period was concentrated among the 2 percent of the survey population whose photofluorograms were classified as showing evidence of cardiovascular disease (bibliog. 8).

The 1946 survey is still being used as the basis for further studies. Careful measurements of subcutaneous fat, heart, and bony thorax have recently been completed on the survey photofluorograms of 30,000 Muscogee County residents. The relationship of subcutaneous fat to race, sex, age, and socioeconomic status has been described (bibliog. 30), and an analysis of the relationship of fatness and body build to tuberculosis and to mortality from all causes over a 15-year period is currently being carried out.

Values of Community-Based Research

From this brief recounting of accomplishments and from the accompanying annotated bibliography it is clear that a wide range of community health research can be successfully conducted within the framework of an operating health department. Furthermore, such a combination of service and research is mutually beneficial. Day-to-day service activities normally generate much information needed for research, and often collect it from a definable segment of the total population.

Community interest and support are much more readily obtained when immediate benefits accompany the less tangible rewards of research. Even the problems associated with the provision of public service may have their use by pointing out areas to the research worker where further knowledge would be most helpful.

Although it is generally acknowledged that research findings will eventually result in improved service, it is not so obvious that participation in research can be beneficial in itself. Planning for a program in which research is to be an intrinsic component is likely to be more than usually thoughtful and comprehensive. Quality of information will be improved by the research requirement that standardized test procedures be applied uniformly to all cate-

gories of subjects. And even when the research goal has little immediately visible application, the stimulus of seeking new knowledge is bound to add the spice of interest to public health practice.

Additional advantages accrue if the basis for research interest is truly communitywide. Even a simple case series has more meaning when it includes all cases recognized within a clearly defined population if for no other reason than the fact that it will usually be more representative than the cases selected by a variety of circumstances for admission to a particular treatment or diagnostic center. Appropriate denominators for a case series lay the foundations for studies of etiology based on determinations of prevalence and incidence in a variety of community subgroups.

As in architecture, if these foundations are both strong and broad, they will not only support the initial research project, but will provide for its growth and for expansion into other areas. A structure of this nature becomes a research facility, in that its design makes possible the easier performance of a variety of investigations. A new idea can often be developed and exploited more readily and at much lower cost in this setting than elsewhere. Findings from a specific investigation are readily put to other uses where the same population is the basis for a series of studies. And as the needs for long-term observations increase, the preservation of the basic data from a communitywide research facility may offer readymade building blocks for the research architects of tomorrow.

Annotated Bibliography

1. COMSTOCK, G. W.: *Tuberculosis studies in Muscogee County, Georgia. I. Community-wide tuberculosis research. Public Health Rep 64: 259-263 (1949).*

A description of the foundation, scope, and aims of the Muscogee County Tuberculosis Study.

2. BURKE, M. H., SCHENOK, H. C., and THRASH, J. A.: *Tuberculosis studies in Muscogee County, Georgia. II. X-ray findings in a community-wide survey and its coverage as determined by a population census. Public Health Rep 64: 263-290 (1949).*

The procedures, findings, and coverage of a mass chest X-ray survey are reported. Not only was this one of the earliest communitywide surveys, but it was also one of the first in which both participants and nonparticipants could be identified by matching survey records against a population census. Participation of households in the survey tended to be an "all-or-none" phenomenon, the examination of one member appearing to increase the probability of other members being examined. The prevalence of chest X-ray findings suggestive of tuberculosis increased with age for all race-sex groups but the increase with age was much more marked for whites than for Negroes.

3. BICKERSTAFF, H. J., COMSTOCK, G. W., and BURKE, M. H.: *Routine antenatal chest X-ray findings in patients drawn from a currently surveyed population. Amer J Obstet Gynec 61: 41-48 (1951).*

Routine chest photofluorography was done at some time in the course of 3,576 pregnancies, which represented about half of those coming to term in the county during the study period. Pulmonary tuberculosis was found in one of every 83 persons examined and nontuberculous pathology, princi-

pally cardiovascular disease, in one of every 113 persons examined. The findings suggested that a screening X-ray film at the time of the initial postpartum visit, while not detecting many cases of previously unknown tuberculosis, would identify a sizable proportion of the active cases among this population.

4. COMSTOCK, G. W., and BURKE, M. H.: *Tuberculosis studies in Muscogee County, Georgia. III. Tuberculosis mortality following a community-wide X-ray survey. Public Health Rep 66: 695-711 (1951).*

An early report showing that tuberculosis mortality was not significantly different among county residents examined in a mass survey and those who were not examined. For a later report, see 13.

5. SHAW, L. W.: *Field studies on immunization against tuberculosis. 1. Tuberculin allergy following BCG vaccination of school children in Muscogee County, Georgia. Public Health Rep 66: 1415-1426 (1951).*

Sensitivity to a small dose of tuberculin was more common among Negro than among white children. But among those who did not react to the small dose, the prevalence of large dose reactors was the same for both races. Large dose reactions did not seem to be the result of tuberculous infection.

Comparison of tuberculin reactions 3 years after a controlled trial of BCG vaccination showed that only a relatively small proportion of the tuberculin sensitivity among the vaccinated group could definitely be attributed to vaccination. This fact could not have been ascertained if the study had not included an adequate control group of children who were not vaccinated.

6. PALMER, C. E.: *The place of tuberculin testing in a tuberculosis control program. Tuberculin testing in relation to BCG. Transactions, 48th annual meeting, National Tuberculosis Association, 1952, pp. 705-716.*

Comparisons of the prevalence of reactions to 5 TU and 100 TU doses of PPD in five different populations again indicated that reactions to 100 TU were not likely to have resulted from infection with *Mycobacterium tuberculosis*. Marked differences in postvaccinal sensitivity were also found in different geographic areas. Evidence is presented to suggest that the low postvaccinal sensitivity in the first BCG trial in Muscogee County was not necessarily related to the vaccine used nor to its method of administration.

7. COMSTOCK, G. W.: *The place of tuberculin testing in a tuberculosis control program. Tuberculin testing in relation to casefinding. Transactions, 48th annual meeting, National Tuberculosis Association, 1952, pp. 726-736.*

The large number of tuberculosis suspects detected in a mass X-ray survey often places a great load on the followup facilities of local health departments. This analysis indicates that suspects with negative reactions to 5 TU of PPD may safely be discharged from further followup.

8. COMSTOCK, G. W.: *Mortality of persons with photofluorograms suggestive of cardiovascular disease. New Eng J Med 248: 1045-1050 (1953).*

Persons with photofluorograms interpreted as showing evidence of cardiovascular disease comprised 1.7 percent of the surveyed population. During an observation period of 3½ years after the survey, this small segment yielded one-quarter of all deaths from cardiovascular-renal diseases occurring among this population.

9. PALMER, C. E., and SHAW, L. W.: *Present status of BCG studies. Amer Rev Tuberc 68: 462-466 (1953).*

This brief, preliminary report of the findings of the controlled trials of BCG vaccination initiated by the Public Health Service includes the two trials conducted in Muscogee County. No indication was found that BCG vaccination was likely to be a useful tuberculosis control procedure in this country.

10. PEEPLES, W. J., and SPENCE, N. J.: *Pulmonary cavitation due to Histoplasma capsulatum. Amer Rev Tuberc 69: 111-115 (1954).*

A case report of a patient with marked pulmonary cavitation and sputum persistently positive for *H. capsulatum* who survived for 12 years without treatment (at time of publication, survival was only 4 years).

11. COMSTOCK, G. W.: *Tuberculosis in mid-century. Bull Muscogee County Med Soc 1 (No. 2): 11-21 (1954).*

A brief report of the tuberculosis problem in Muscogee County from 1946 to 1954.

12. COMSTOCK, G. W., and SARTWELL, P. E.: *Tuberculosis studies in Muscogee County, Georgia. IV. Evaluation of a community-wide X-ray survey on the basis of six years of observation. Amer J Hyg 61: 261-285 (1955).*

A detailed description of followup procedures is given. The yield of infectious cases detected by a mass survey was trebled by intensive, prolonged followup.

The prevalence of active tuberculosis increased with age for all race-sex groups except Negro females. The problem of cases missed by the survey reading was important even though photofluorograms had been interpreted by two readers. The incidence of new cases of tuberculosis was higher among Negroes than among whites and slightly higher among males than females. Among whites, incidence was greater above age 45, whereas among Negroes it was greater below the age of 45.

13. COMSTOCK, G. W.: *Tuberculosis studies in Muscogee County, Georgia. V. Tuberculosis mortality during seven years after a community-wide survey. Amer Rev Tuberc 73: 157-164 (1956).*

Tuberculosis deaths occurring among participants and nonparticipants in a chest X-ray survey gave no indication that persons who suspected they might have tuberculosis tended to avoid examination in the survey. Annual death rates among persons classified by the survey as tuberculous were high: 340 per 100,000 for whites and 1,490 for Negroes. Among persons with survey films classified as negative, the death rate for whites was only 3 per 100,000, but for Negroes the rate was 45.

14. COMSTOCK, G. W., VAUGHN, R. H., and MONTGOMERY, G.: *Outcome of solitary pulmonary nodules discovered in an X-ray screening program. New Eng J Med 254: 1018-1022 (1956).*

Only 4 of 88 solitary pulmonary nodules detected in a communitywide screening program were found to be malignant and 5 were tuberculous. Nodules larger than 28 mm. in diameter were likely to be malignant or tuberculous; those with calcification or lamination were likely to be benign.

15. COMSTOCK, G. W.: *An epidemiologic study of blood pressure levels in a biracial community in the southern United States. Amer J Hyg 65: 271-315 (1957).*

Blood pressure determinations were made on a representative sample of the 1946 census population still residing in Muscogee County in 1954. Readings were taken at home with standardized procedures by trained observers. Negroes had higher blood pressures than whites. In early adult life, males had higher systolic pressures than females; after age 40, this relationship was reversed. Males generally had higher diastolic pressures than females. For all groups, mean pressures rose with age; this was more marked for systolic than for diastolic pressures. Among Negroes, persons with a previous history of syphilis had higher blood pressures than those with no history of syphilis.

16. COMSTOCK, G. W., and KENDRICK, M. K.: *Blood pressure and the weather. Amer Heart J* 53: 825-828 (1957).
- Changes in barometric pressure, temperature, and relative humidity did not appear to affect blood pressure.
17. PALMER, C. E., SHAW, L. W., and COMSTOCK, G. W.: *Community trials of BCG vaccination. Amer Rev Tuberc* 77: 877-907 (1958).
- The results of two controlled trials of BCG vaccination, one in Puerto Rico, the other in Muscogee County, Ga., and Russell County, Ala., are reported. More than a quarter of a million persons participated in these studies. In both areas, the bulk of tuberculosis cases came from persons previously infected and ineligible for vaccination. Among nonreactors, tuberculosis rates were low and were diminished only moderately by BCG vaccination. "Because BCG cannot help those who are already infected, nor those who will not become infected, and may be helpful only to a portion of the decreasing few who will become infected in the future, it is apparent that vaccination cannot be very useful in controlling tuberculosis in this country."
18. KELTZ, H., and COMSTOCK, G. W.: *Serum globulin levels in whites and Negroes. New Eng J Med* 260: 1268-1271 (1959).
- Negroes were found to have significantly higher globulin levels than white persons. The higher concentration of globulin among Negroes was not related to infection with syphilis or tuberculosis and may well be a racial characteristic.
19. COMSTOCK, G. W., and PORTER, M. E.: *Tuberculin sensitivity and tuberculosis among natives of the lower Yukon. Public Health Rep* 74: 621-634 (1959).
- The prevalence of tuberculin sensitivity indicated a high infection rate in the lower Yukon area, but prevalence of disease did not vary with size of tuberculin reaction. In Muscogee County, Ga., and Russell County, Ala., on the other hand, prevalence of tuberculosis was much greater among persons with large tuberculin reactions than among those with small reactions.
20. EDWARDS, L. B., and PALMER, C. E.: *Isolation of "atypical" mycobacteria from healthy persons. Amer Rev Resp Dis* 80: 747-749 (1959).
- Atypical mycobacteria were isolated from the sputum or saliva of 13 percent of the healthy adult population of a small rural community in southwestern Georgia.
21. EILERTSEN, E., and COMSTOCK, G. W.: *Correspondence regarding "Community trials of BCG vaccination." Amer Rev Resp Dis* 81: 932-933 (1960).
- Questions and answers, mostly about the BCG trial in Puerto Rico. (See 17.)
22. COMSTOCK, G. W.: *Letter to the editor. BCG vaccination. Tubercle* 41: 227-229 (1960).
- Possible sources of bias in the recognition of tuberculosis cases arising among controls and vaccinees in the two community BCG trials are discussed, with additional evidence that such bias did not occur.
23. COMSTOCK, G. W., and SHAW, L. W.: *Controlled trial of BCG vaccination in a school population. Public Health Rep* 75: 583-594 (1960).
- A report of 12 years of observation of a study group of approximately 11,000 school children. Half of those eligible for vaccination were vaccinated with BCG, and half were left unvaccinated as controls. Reactors to the 5 TU dose of PPD comprised only 7 percent of the study population but yielded 70 percent of the cases. No benefit from BCG vaccination could be demonstrated.
24. COMSTOCK, G. W.: *A comparison of purified tuberculins in the southeastern USA. Bull WHO* 23: 63-688 (1960).
- Low-grade tuberculin sensitivity among children in Muscogee County, Ga., and Russell County, Ala., presumably nonspecific in nature, was evoked by RT 19-20-21 more frequently than by PPD-S. Some problems encountered in standardizing tuberculin preparations in human populations are discussed.
25. DAVIS, S. D., and COMSTOCK, G. W.: *Mycobacterial cervical adenitis in children. J Pediat* 58: 771-778 (1961).
- Most chronic cervical adenitis among children in Muscogee County, Ga., appeared to have resulted from infection with mycobacteria other than *Mycobacterium tuberculosis*. Clinical features are given for a series of 24 cases, which comprised all known cases in the area since 1946.
26. COMSTOCK, G. W., KELTZ, H., and SENCER, D. J.: *Clay eating and sarcoidosis. Amer Rev Resp Dis* 84 (No. 5, supp.): 130-134 (1961).
- A case-control study of sarcoidosis showed that pregnancy, eating of clay in adult life, use of chewing tobacco, frequent eating of candy, and rural residence at some time were attributes positively associated with sarcoidosis. Attributes negatively associated with sarcoidosis were cigarette smoking and family history of tuberculosis.
27. FEREBEE, S. H., and MOUNT, F. W.: *Tuberculosis morbidity in a controlled trial of the prophylactic use of isoniazid among household contacts. Amer Rev Resp Dis* 85: 490-521 (1962).
- Muscogee County was one of 39 cooperating health departments in a controlled trial of isoniazid prophylaxis among contacts of newly diagnosed tuberculosis cases. The trial demonstrated that the risk of developing tuberculosis was high for contacts during the first year after diagnosis of a case in the household and that the daily administration of isoniazid for 1 year was very effective in reducing this risk.
28. MOUNT, F. W., and FEREBEE, S. H.: *The effect of isoniazid prophylaxis on tuberculosis morbidity among household contacts of previously known cases of tuberculosis. Amer Rev Resp Dis* 85: 821-827 (1962).

Muscogee County was one of five counties participating in this trial among contacts of previously known cases of tuberculosis. Although the tuberculosis risk was much lower for this group than for contacts of recently diagnosed cases, isoniazid appeared to be an effective prophylactic agent in this group also.

29. COMSTOCK, G. W.: *Untreated inactive pulmonary tuberculosis. Risk of reactivation. Public Health Rep 77: 461-470 (1962).*

The risk of developing active tuberculosis was found to be substantial even after 2 years had elapsed without manifestations of active disease. The risk was greater for persons with advanced than with minimal disease, greater for Negroes than for whites, and greater for young persons than for older persons. Among Negroes, the risk of reactivation was not associated with degree of skin pigmentation.

30. COMSTOCK, G. W., and LIVESAY, V. T.: *Subcutaneous fat determinations from a community-wide chest X-ray survey in Muscogee County, Georgia. Ann NY Acad Sci 110: 475-491 (1963).*

Measurements were obtained on nearly 30,000 persons, accounting for 40 percent of the population over 10 years of age. Subcutaneous fat was measured at trapezius and flank sites. Fatness was greater among females than among males, and slightly greater among the well-to-do than among the poor, except for white females over the age of 45. Among males, fat increased with age from 10 to 35 years, and remained relatively constant thereafter. Among females, subcutaneous fat increased until age 50 and decreased thereafter.

31. KENDRICK, M. A.: *The relationship of housing to tuberculosis in Muscogee County, Georgia. The Catholic University of America Studies in Sociology Abstract Series, Vol. 4. Catholic University of America Press, Washington, D.C., 1957, pp. 1-33.*

Tuberculosis incidence, prevalence, and mortality were slightly greater among 1946 survey participants with poor housing conditions than among those with good housing. The association of tuberculosis with poor housing was not nearly as marked as had been reported from other studies.

NIMH Director Retires

Dr. Robert H. Felix, director of the National Institute of Mental Health since its establishment in 1949, retired October 1 to become dean of the School of Medicine, St. Louis University, at St. Louis, Mo. He is a recipient of the 1964 Bronfman Prize for Public Health Achievement.

Since being commissioned in the Public Health Service in 1933, Dr. Felix has served as clinical director and executive officer of the Public Health Service Hospital at Lexington, Ky., assistant chief, Division of Hospitals, and as chief of the Division of Mental Hygiene, predecessor of the National Institute of Mental Health. In that position, he helped to develop the National Mental Health Act of 1946 and to prepare the groundwork for the national mental health program he has administered since 1949.

Dr. Felix was a leader in developing the community-based comprehensive treatment program, to be administered by the Institute under the Community Mental Health Centers Construction Act of 1963. His achievements have been recognized by many professional and academic honors.